The Impact of Bias Correction of Climate Data on Vegetation and Soil Carbon Dynamics

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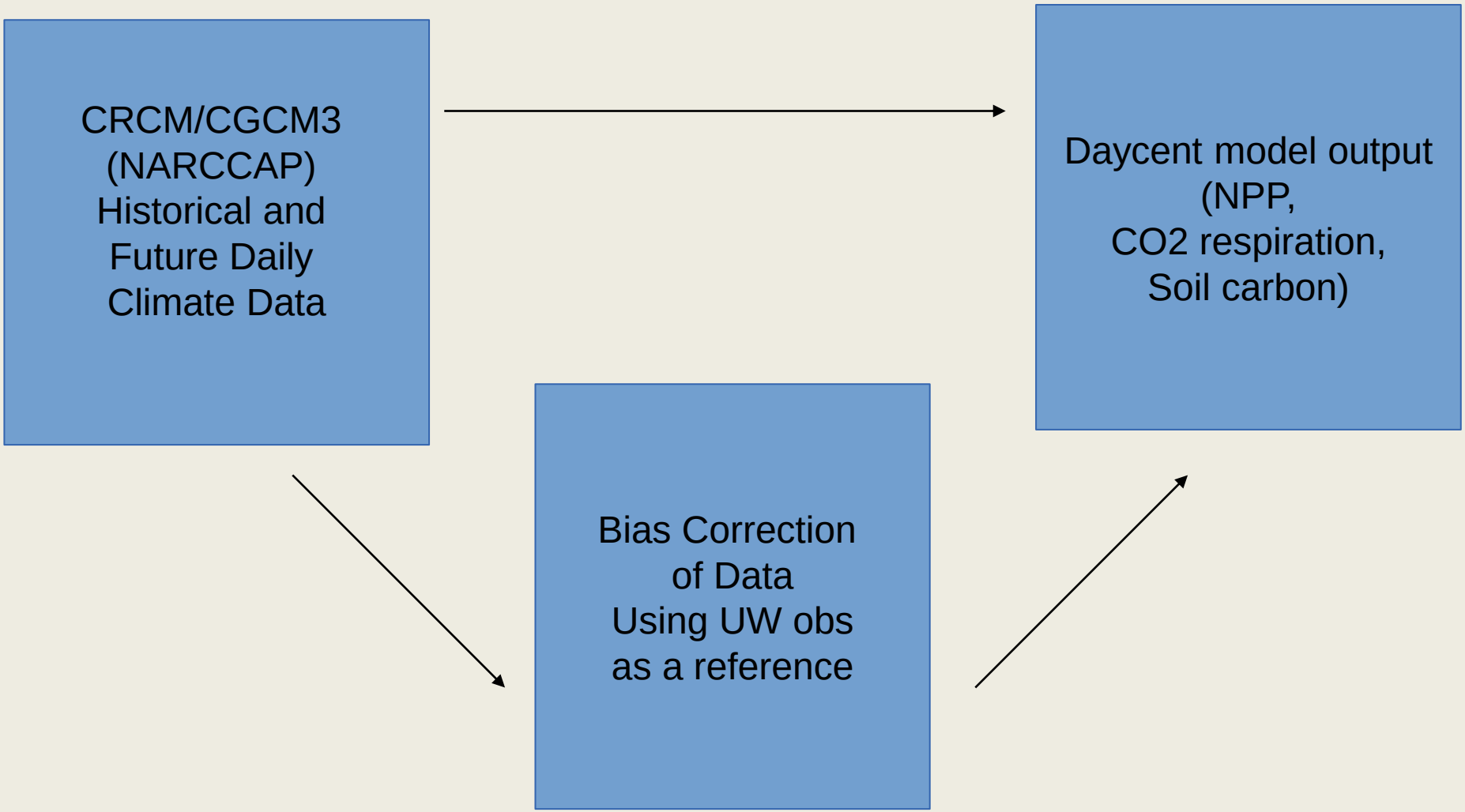
Goal

Impact of bias correction on vegetation modeling using Daycent model



Methodology

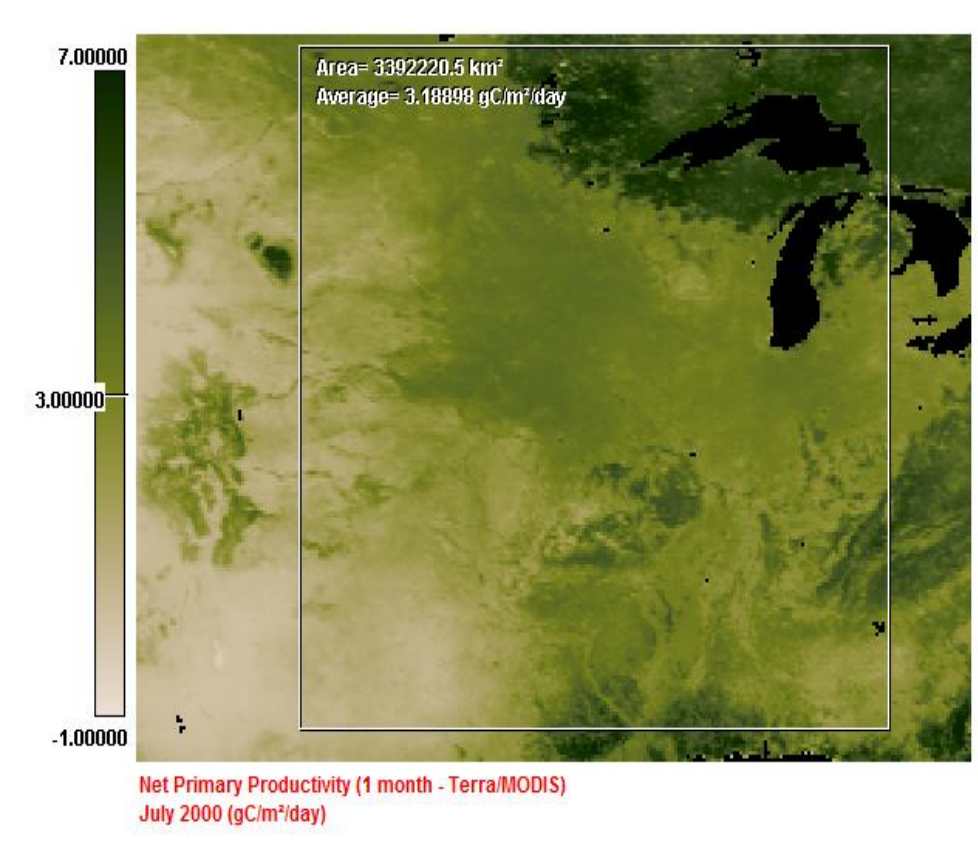
- Bias Correction of daily minimum temperature, maximum temperature and precipitation
- Resize and transform UW observational dataset (1/8th degree) to agree spatially with NARCCAP's CRCM/CGCM3 dataset (50km)
- Correct precipitation frequency with threshold value
- Use CDF to correct for precipitation intensity (gamma distribution) and minimum and maximum temperature differences (empirical CDF)
- Changes made to equalize the observation and model CDFs saved and applied to future model datasets as well

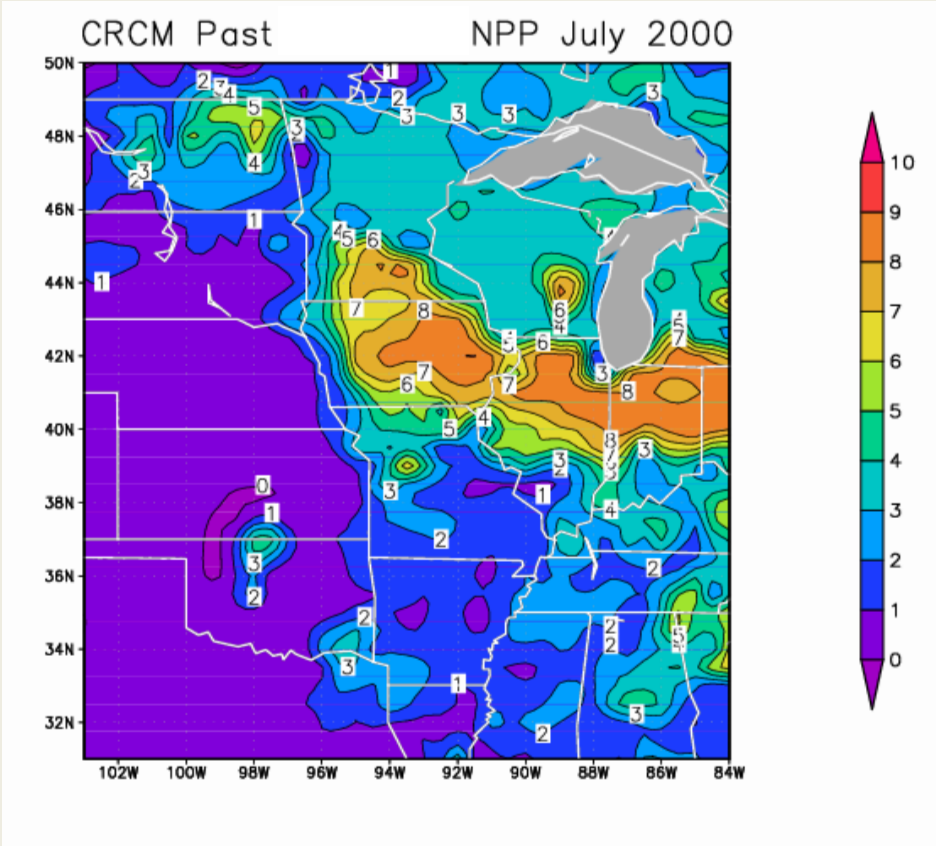
Methodology

- Daycent model: Biogeochemical Model
- Run for multiple, independent locations
- Simulates soil carbon, soil respiration rates, net primary productivity
- Midwestern domain: Agriculture

Results

Daycent Model Validation



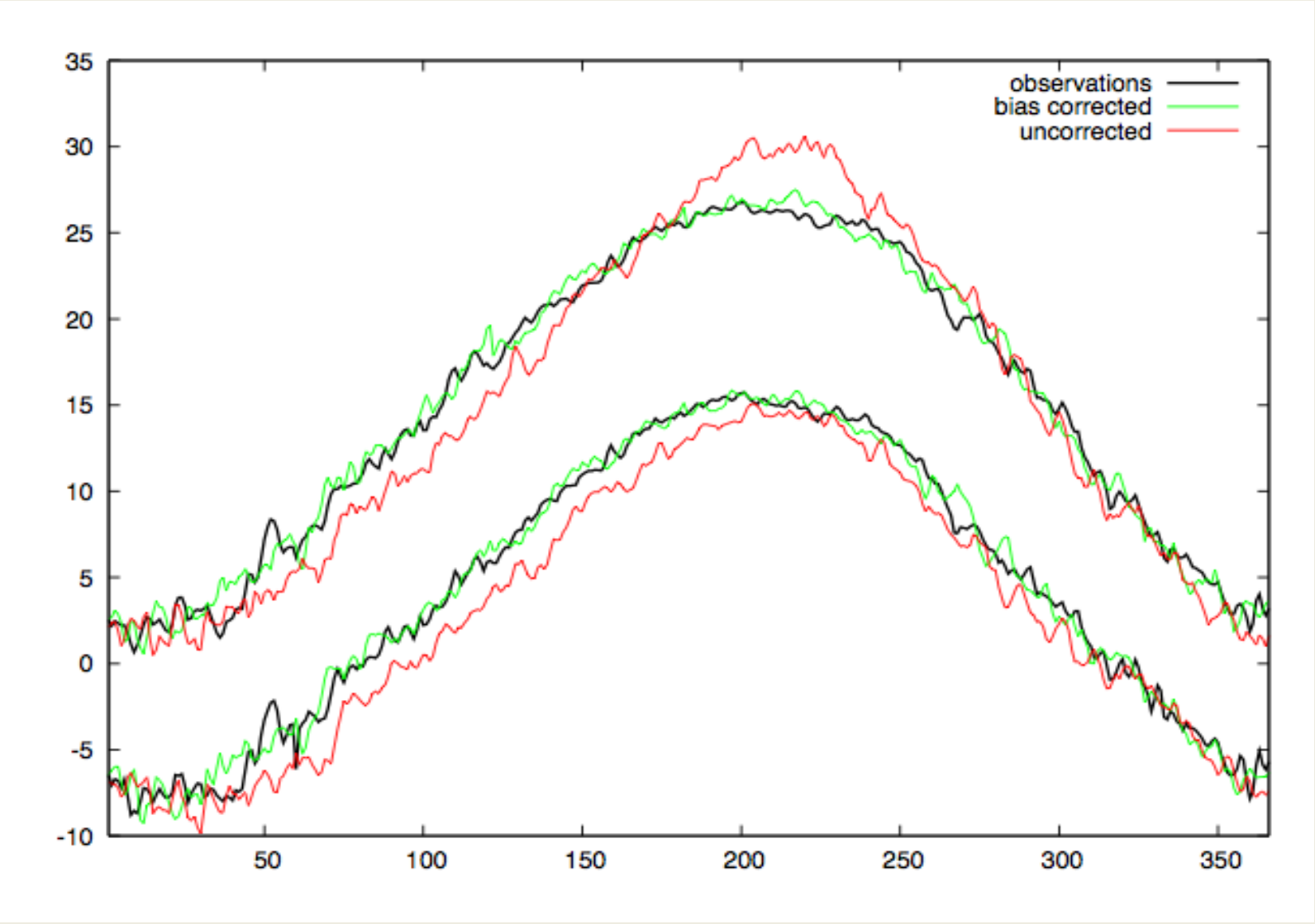


Observed NPP (MODIS satellite data) and Daycent NPP (using CRCM model data as input) for July 2000

Domain averages: Observed=3.19 g/m^2/day Model: 3.033 g/m^2/day

Results

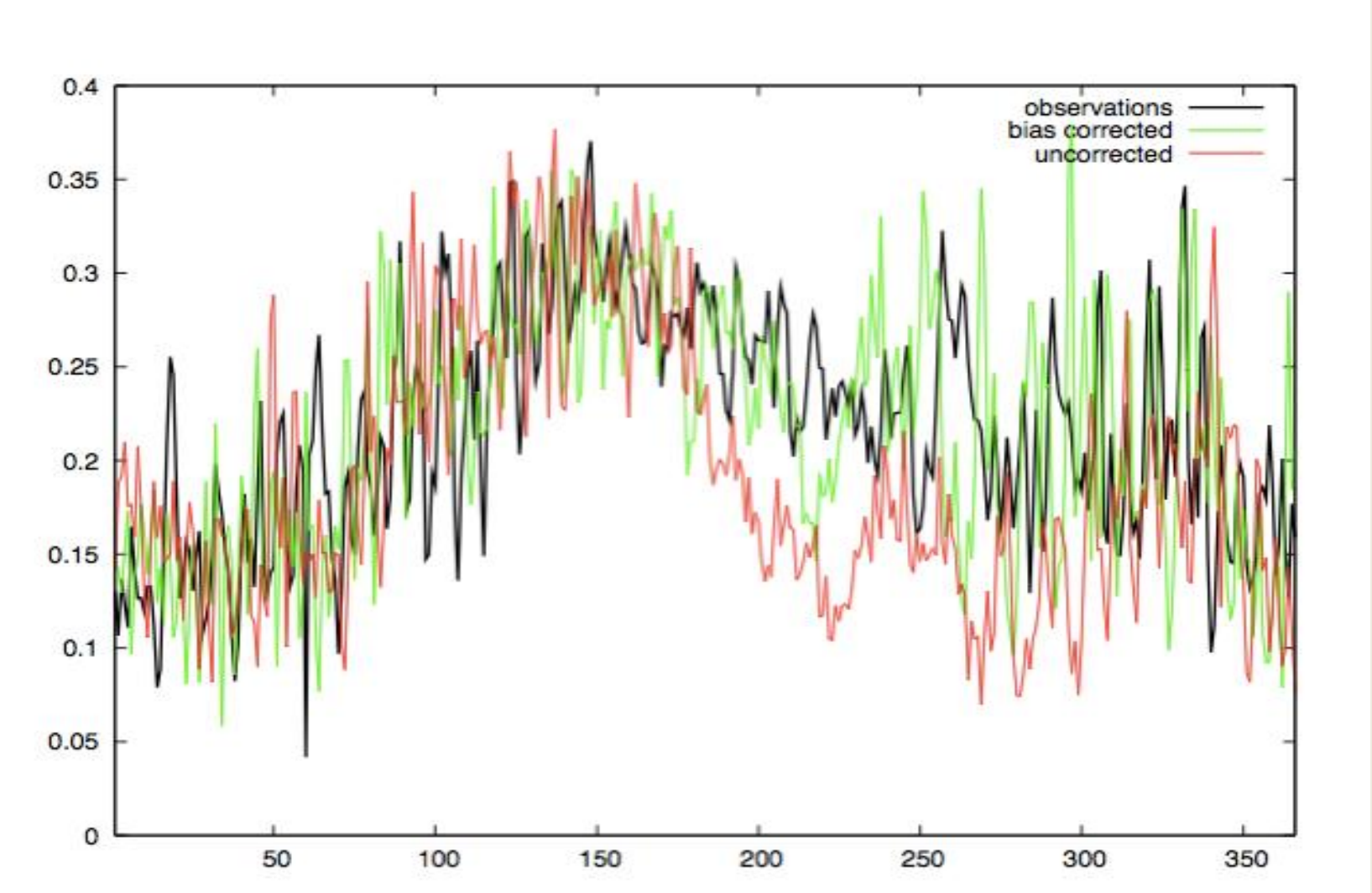
Bias Corrected Climate Data



Daily minimum and maximum temperature (°C) averaged over the domain for 1978-1997 for the observed (black lines), the CRCM uncorrected (red lines) and the bias corrected dataset (green lines).

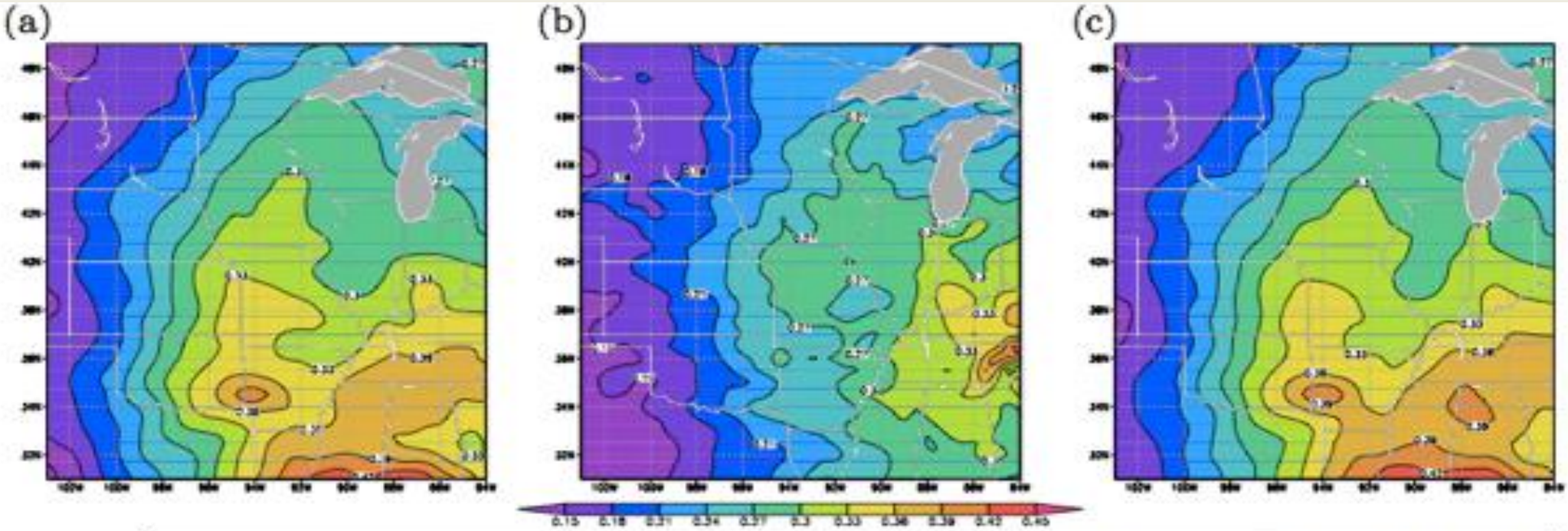
Results

Bias Corrected Climate Data



Daily precipitation (cm/day) averaged over the domain for 1978-1997 for the observed (black line), the CRCM uncorrected (red line), and the bias corrected dataset (green line).

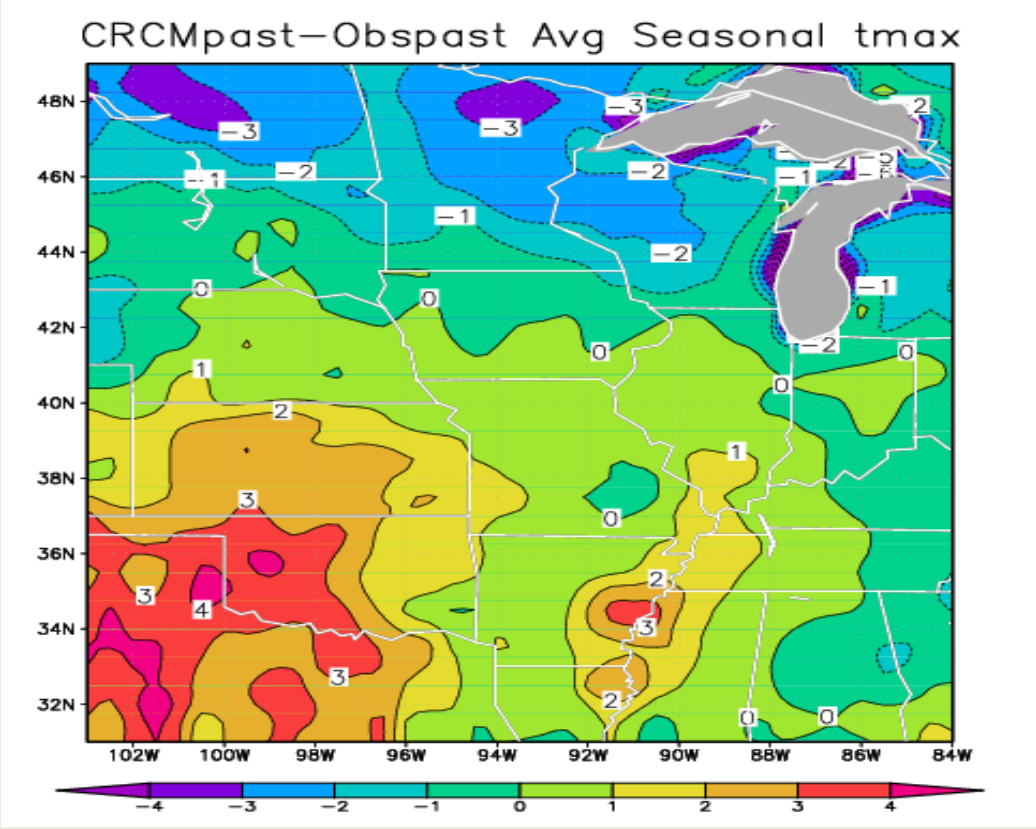
Bias Corrected Climate Data: Precipitation



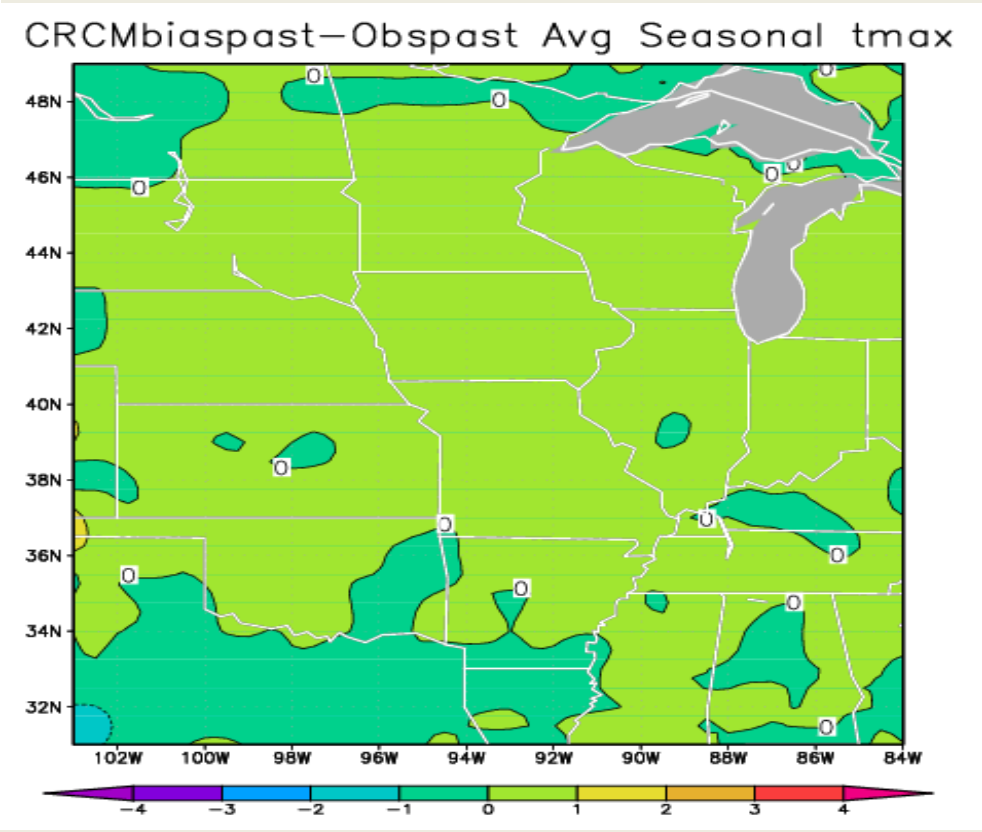
A comparison of precipitation (cm/day) averaged from 1978-1997 (March through October) for (a). the observed, (b). the CRCM and (c). the bias corrected dataset.

Bias Corrected Climate Data: Temperature

a.



b.



Differences in daily average maximum temperature for the growing season (Mar-Oct) between the observations and the (a.) CRCM data (b.) bias corrected data

Bias Corrected Climate Data

	Past Observations	CRCM Past	Bias corrected Past	CRCM Future	Bias corrected Future
Maximum Temperature (°C)	17.54	17.19	17.58	19.67	20.31
Minimum Temperature (°C)	4.69	3.02	4.70	5.70	7.48
Precipitation (cm/day)	0.247	0.218	0.246	0.231	0.252

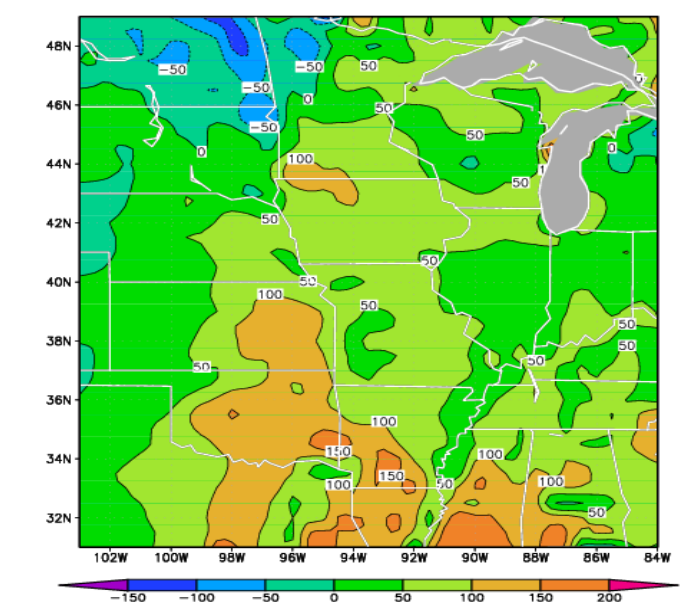
Domain averaged temperature and precipitation values for 1978-1997 (past) and 2046-2065 (future) for March through October for each year for the observed, the CRCM uncorrected and the bias corrected dataset.

Results

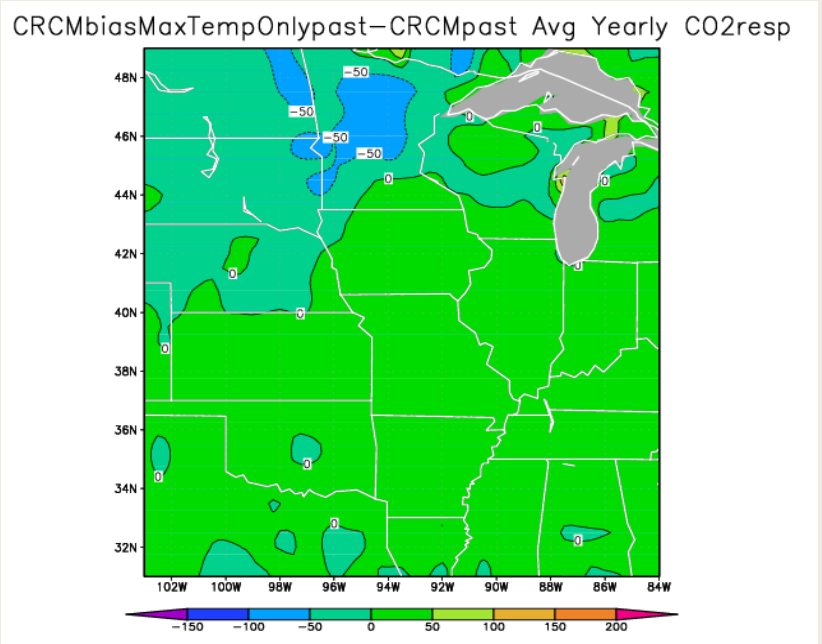
Historical Case: CO2 Respiration

Differences in average yearly (Mar-Oct) CO2 respiration ($gC/m^2/year$) between the original CRCM case and the (a) bias correction case (b) bias correction of maximum temperature only (c) bias correction of minimum temperature only (d) bias correction of precipitation only

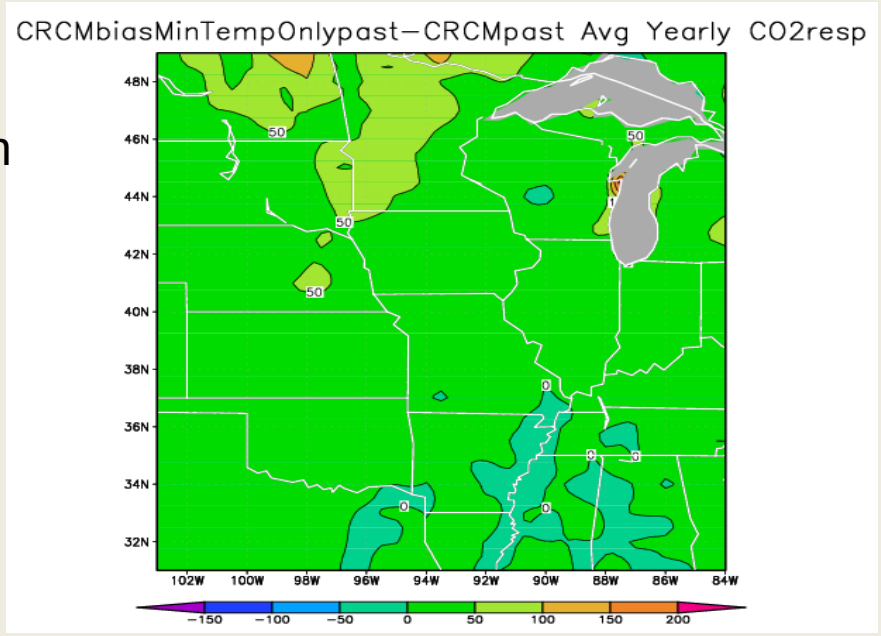
a.



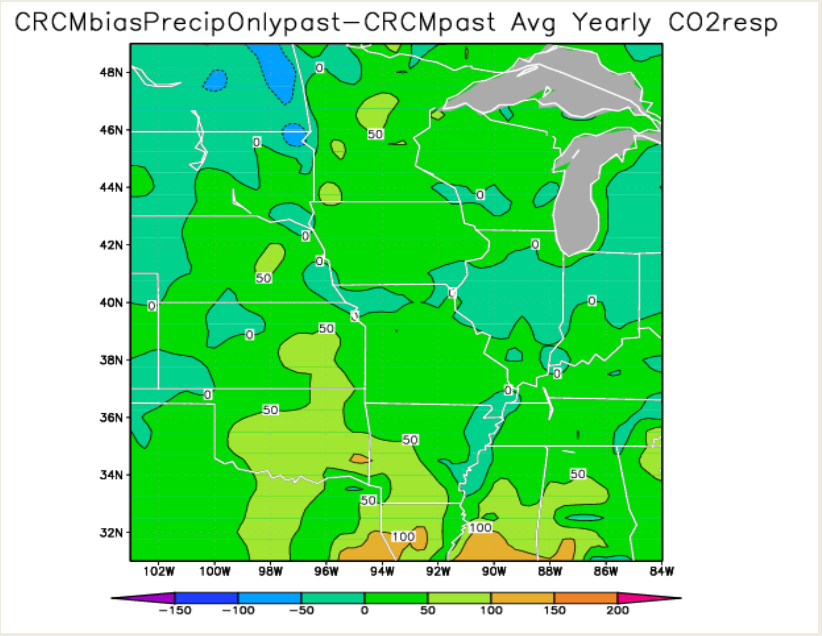
b.



c.



d.

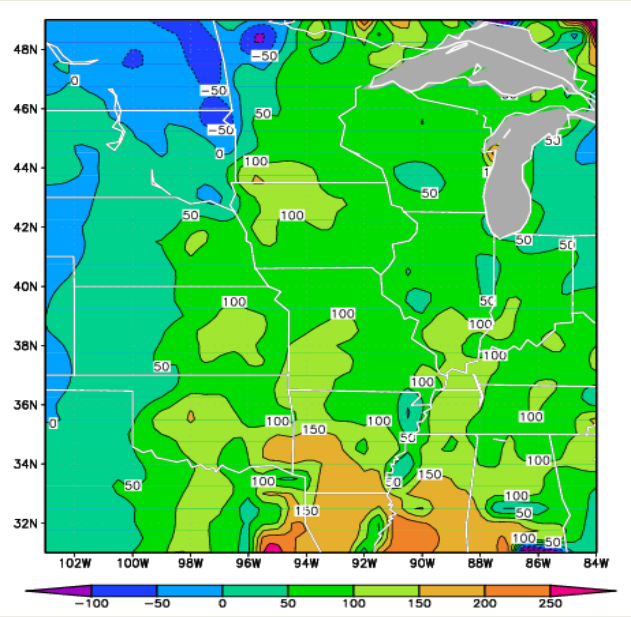


Results

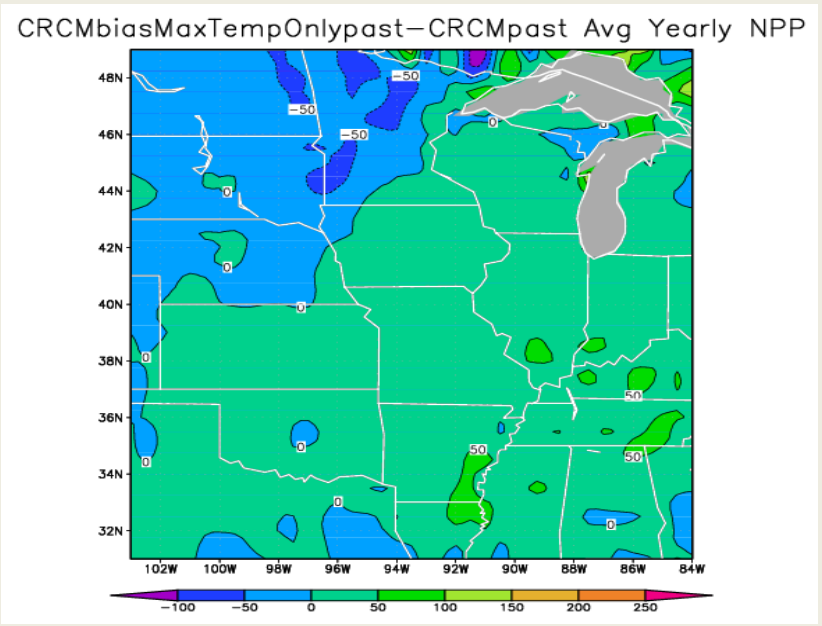
Historical Case: NPP

Differences in average yearly (Mar-Oct) NPP (gC/m^2/year) between the original CRCM case and the (a) bias correction case (b) bias correction of maximum temperature only (c) bias correction of minimum temperature only (d) bias correction of precipitation only

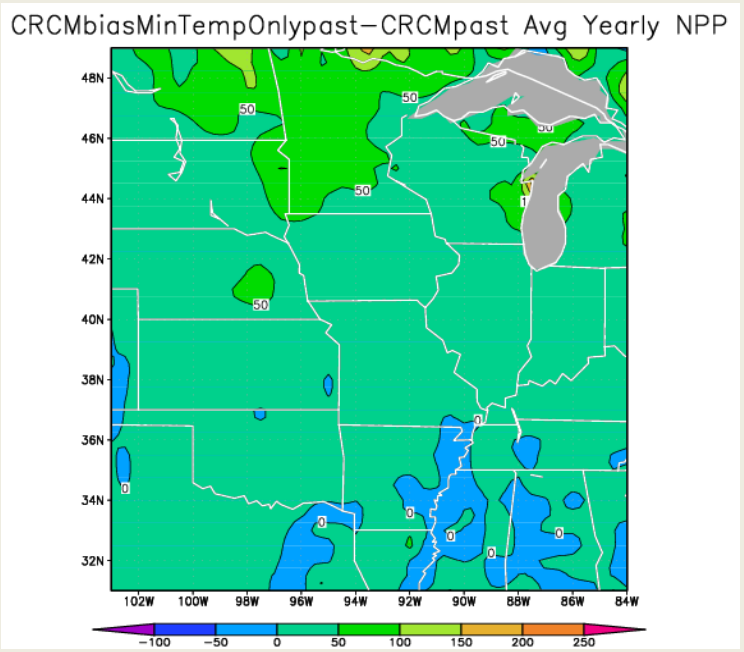
a.



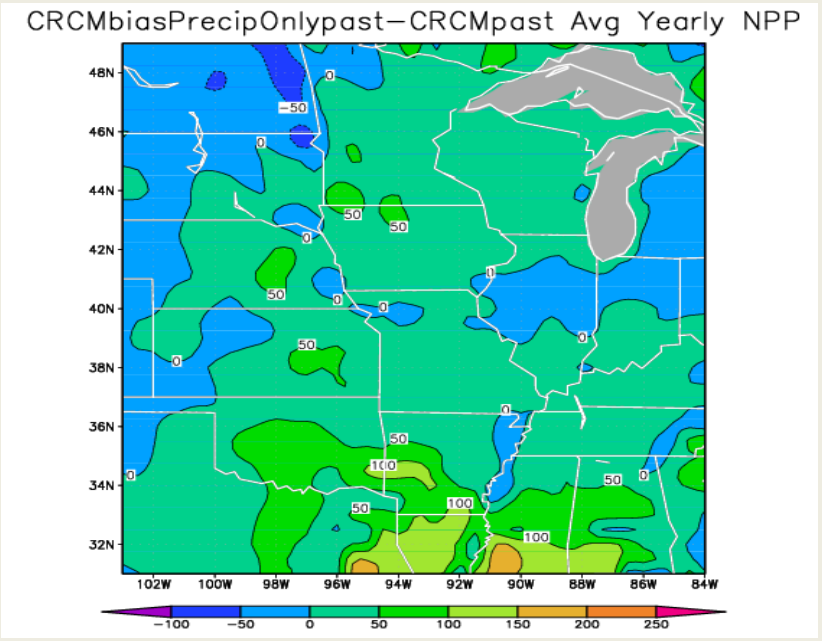
b.



c.



d.

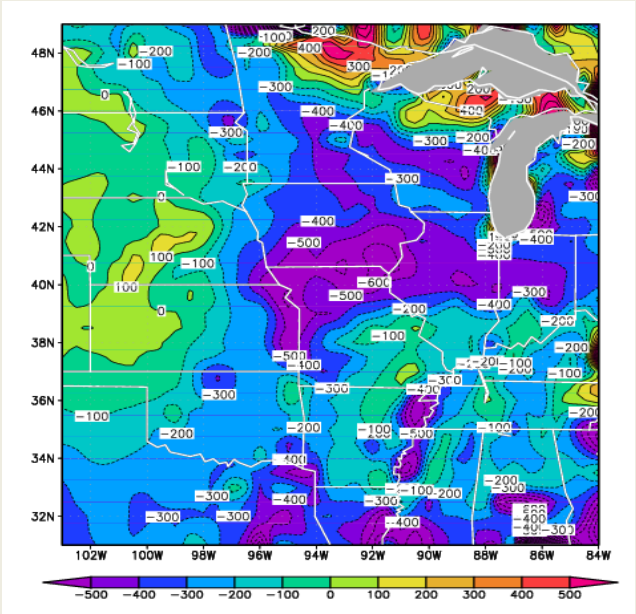


Results

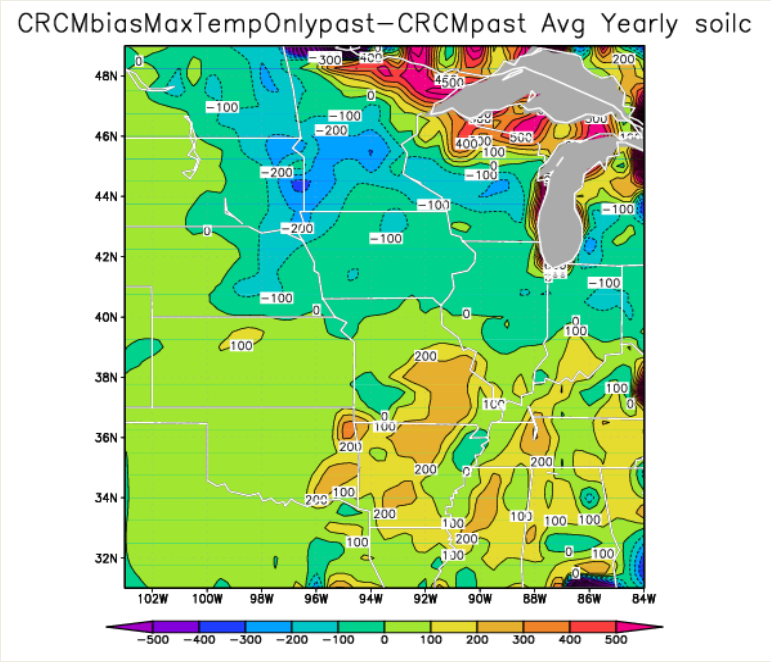
Historical Case: Soil Carbon

Differences in average yearly (Mar-Oct) soil carbon (gC/m^2) between the original CRCM case and the (a) bias correction case (b) bias correction of maximum temperature only (c) bias correction of minimum temperature only (d) bias correction of precipitation only

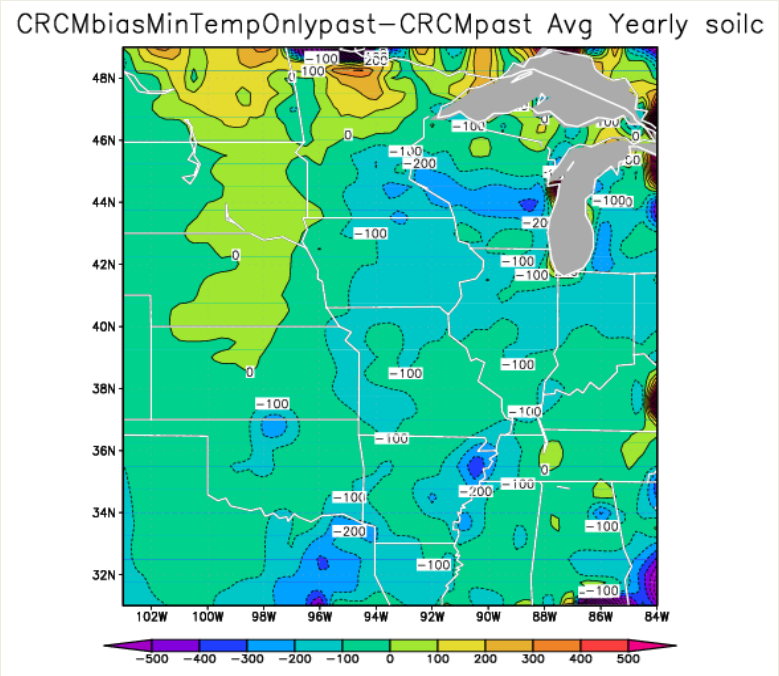
a.



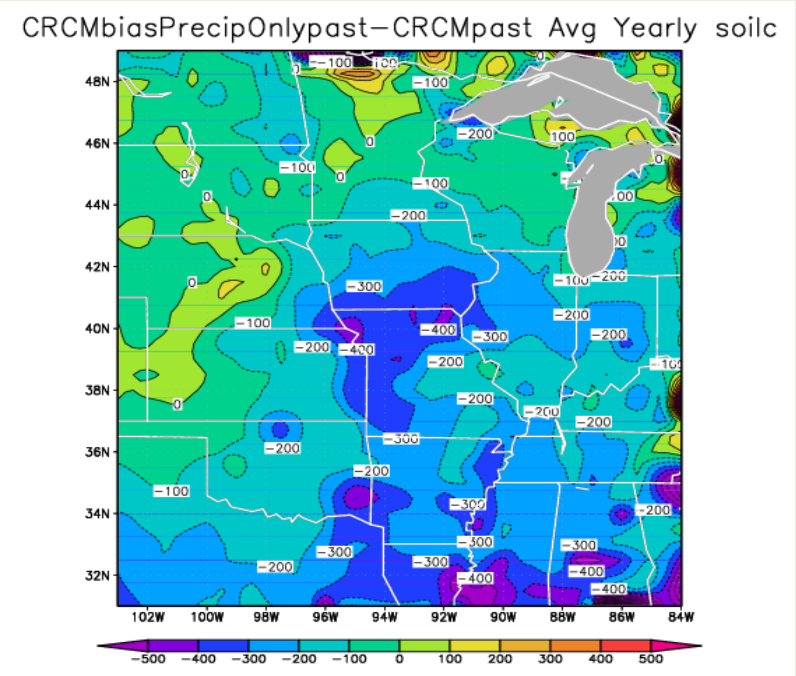
b.



c.



d.



Results

Bias corrected weather data used as input into Daycent resulted in an increase in NPP, an increase in CO2 respiration, and a decrease in soil carbon.

	RCM Past - Bias corrected Past	RCM Future - Bias corrected Future
NPP ($gCm^{-2}yr^{-1}$)	-21.19%	-29.44%
CO2 Respiration ($gCm^{-2}yr^{-1}$)	-19.51%	-22.08%
Soil Carbon (gCm^{-2})	4.25%	3.47%

Percent differences between the bias corrected case and the CRCM case of domain averaged NPP, CO2 respiration and soil carbon values for 1978-1997 (past) and 2046-2065 (future) time periods.

Conclusions

- NPP, CO2 respiration and soil carbon all varied greatly when bias corrected data were used as input into the Daycent model rather than the original model data

- Bias correction of each climate variable individually helps give insight into the model's sensitivity to each parameter.

- Assuming bias correction helps with the accuracy of future climate data as well, it may be very important in the assessment of future agriculture and soil carbon levels.